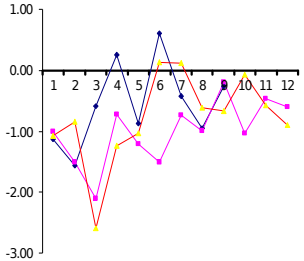

US Army Corps of Engineers®

SEMP Historical Meteorology Evaluation For the Area Near Fort Benning for the Years 1999-2001

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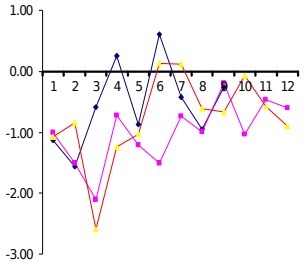
ERDC-CERL

Historical



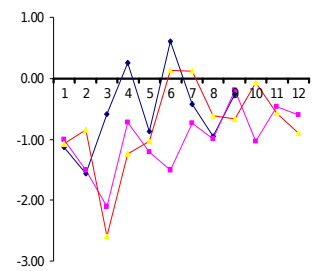
Objective

To determine how aberrant the weather of the first three SEMP data collection seasons (the *Study Years*) was in terms of the Fort Benning climate, and to project the possible effect of these unusual years on the validity of models developed using these data.

Data Types and Sources:

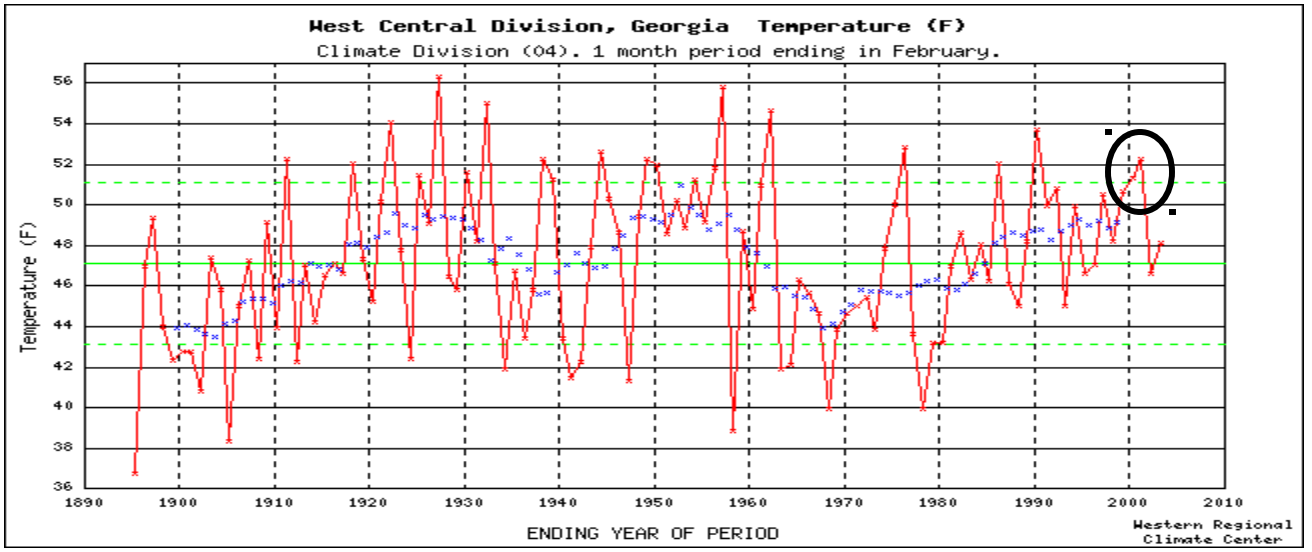
- Temperature - Desert Research Institute Climate Center
- Precipitation - Desert Research Institute Climate Center & Southeast Regional Climate Center
- Stream Flow – United States Geologic Survey

Historical



Temperature

For 1999 – 2001 the average monthly temperatures were 3.4, 3.9 and 5.2 degrees above the long-term average of 47.1 degrees, the latter two above the first Root Mean Square (RMS).

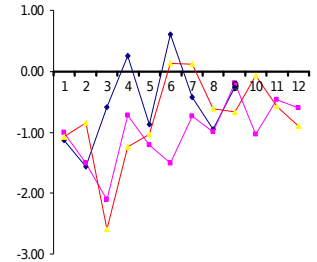


red - 12 month period
blue - 10 year running mean
green - average (solid), ± sigma (dashed)

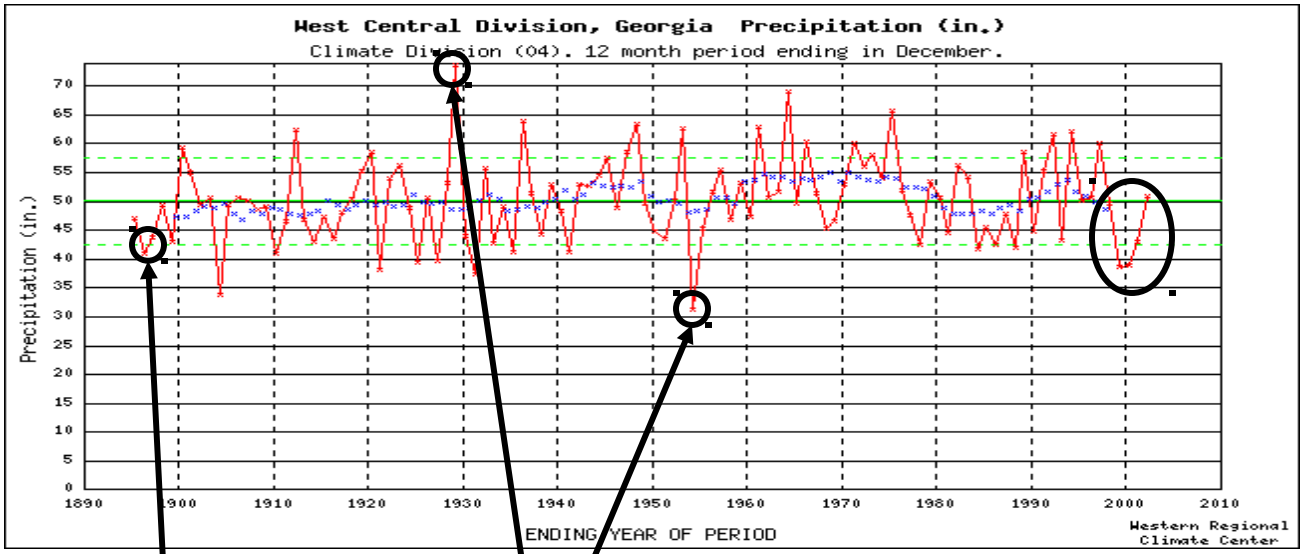
Trends:

- Periods of warmer and colder weather have occurred in lengths of roughly 16.5 years.
- The Study Years are unusual because their averages were noticeably above the 10 year moving average (roughly 49.5 degrees F.) by +0.9, +1.4 and +1.7 degrees for 1999, 2000, and 2001 respectively.
- Therefore all three years can be characterized as warm in a warm period.

Historical



Precipitation



- 1999, 2000 – much drier than average; driest since 1954.
- 2001 also dry.
- Years preceding were wetter than usual; enhancing contrast.
- Study years are not unusual - similar dry years (~1 RMS) have occurred 20 times previously (~20%).

Two significant drought years in a row have previously occurred.

Much more extreme events

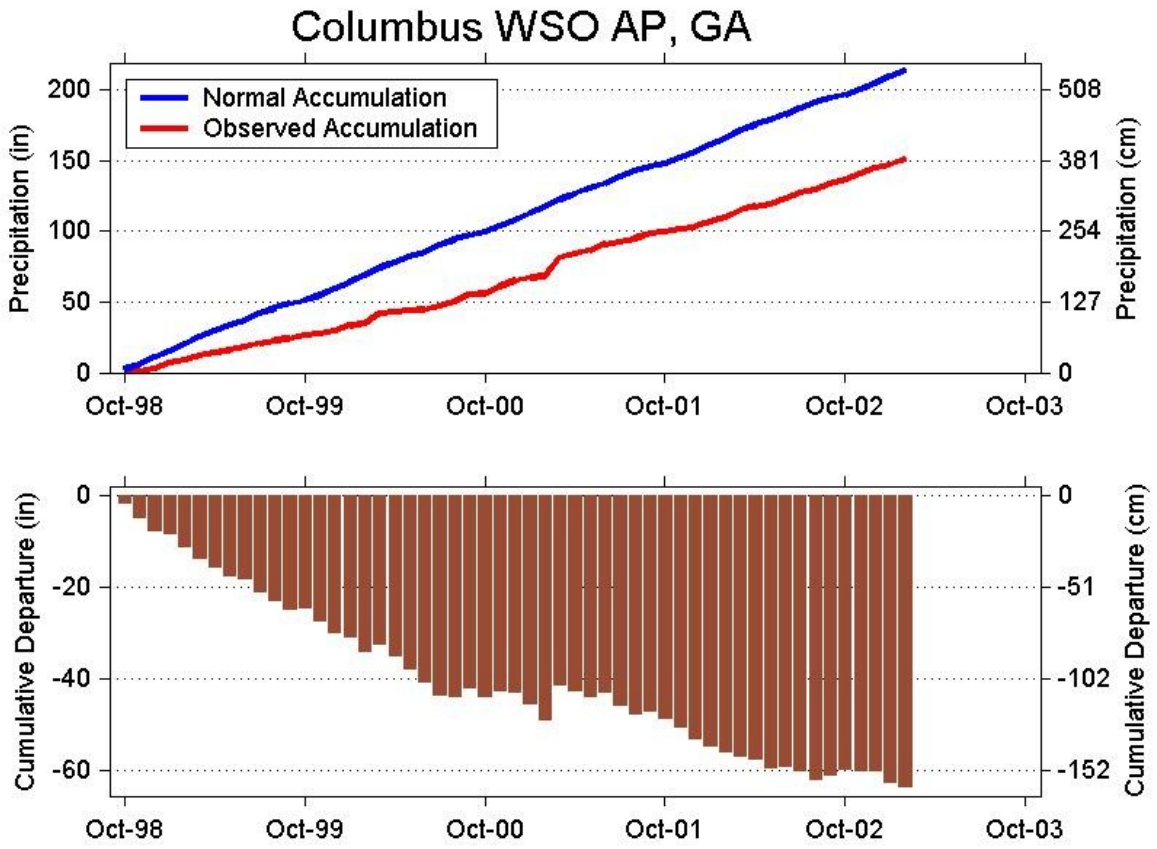
red - 12 month period
blue - 10 year running mean
green - average (solid), ± sigma (dashed)

- A precipitation trend is more difficult to see; might be ~ 12 years long.
- Neither the length nor the years of a precipitation trend coordinate with those for temperature; precipitation & temperature appear to vary independently.
- If forced to say the 1999 – 2001 years represent a part of a trend, they may be the initial part of a cycle. But supplemental data for 2003 show recent average to high precipitation.

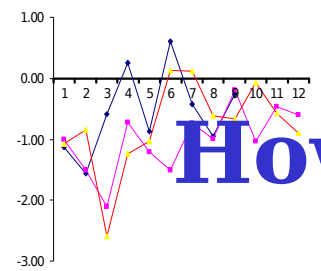
Hint to high

More Recent Precipitation Data

- **An increasing precipitation deficit occurs from October 1998 to about June 2000.**
- **From July 2000 to June 2001, roughly average precipitation occurred.**
- **From July 2001 to April 2002 another deficit period took place.**
- **Average precipitation was experienced from May 2002 to January 2003.**



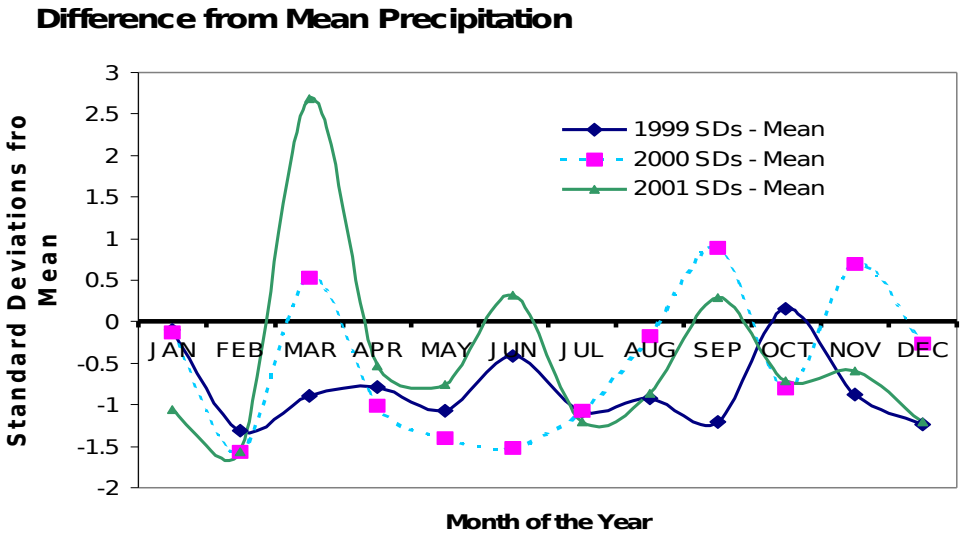
Historical



How Unusual is the Study Period Precipitation?

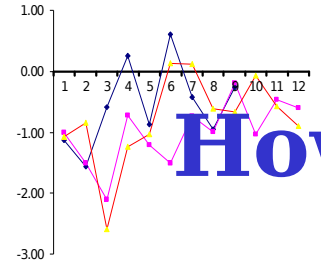
- **From WSO data for Columbus GA**
- **To compare the study period with the more than fifty years of data available.**
- **Monthly data begins in 1948**

Observations:



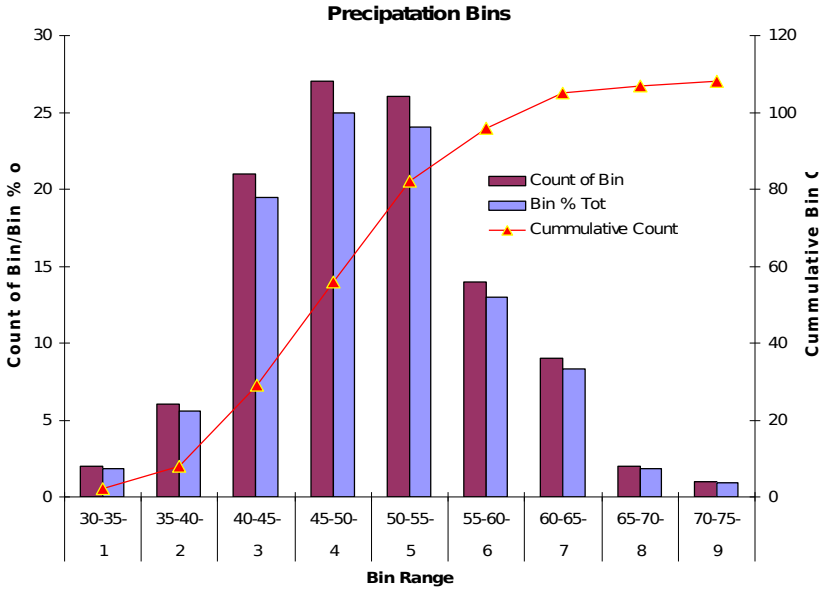
- **Most of 1999 was a deficit year at -0.81SD (except for October which was normal).**
- **If one SD represents 65% of the variation, a year like 1999 is still within roughly 2/3 of all years observed.**
- **Most of 2000 was a deficit year at –0.48SD – nearly a half standard deviation (although several months were roughly normal).**
- **Most of 2001 was a deficit year at –0.43SD – nearly as dry as the previous year in spite of a huge positive peak in March.**

Historical



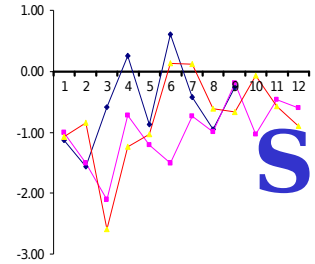
How Unusual is the Study Period Precipitation?

- Longer period data from th West Central section of Georgia.
- Precipitation data divided into nine “five-inch groups” covering the range of data from 30 inches as a low to 75 inches as a high.
- Purpose: To find out the frequency of occurrence of precipitation amounts in each group.



Observations:

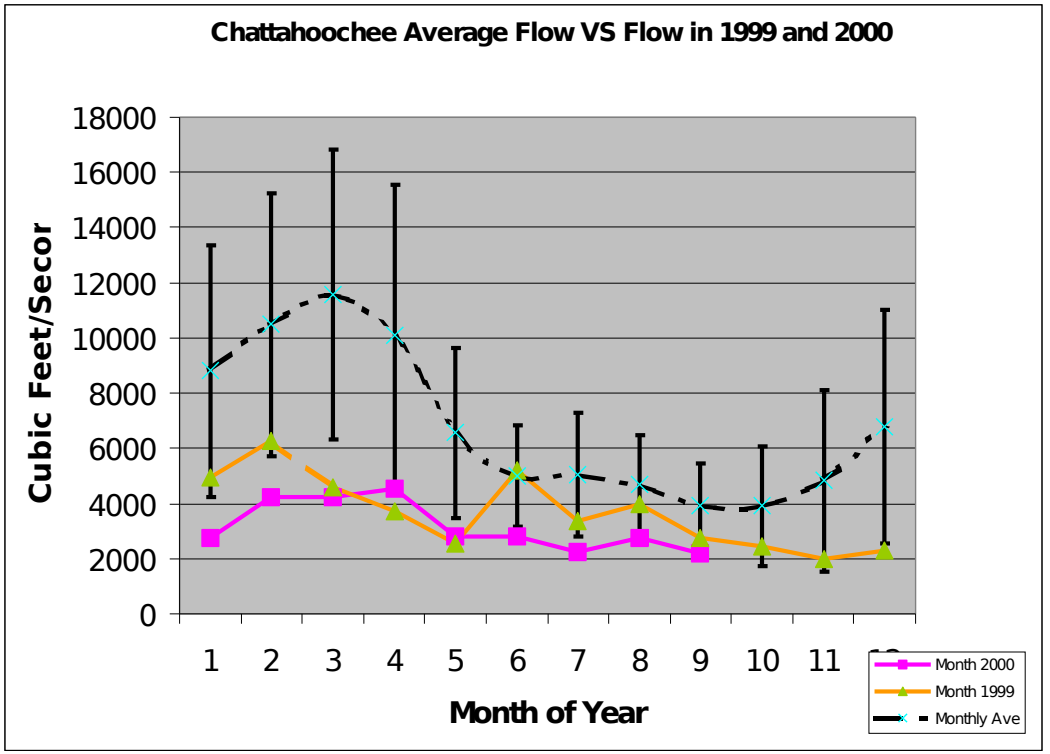
- Years 1999 & 2000 fall in the 35-40“ range: expected 5.5% of the time.
- Year 2001 falls in the 40-45 inches range: expected 19.4% of the time.
- None of these years fell into the lowest precipitation range.
- Issue: How unusual are consecutive draught years? Similar low levels of precipitation previously occurred in 1896 and 1897
  - Coordinates directly with the official estimation that a drought like that during the Study Years occurs Historical every 50 or 100 years



Stream Flow - Chattahoochee River

Normal Characteristics:

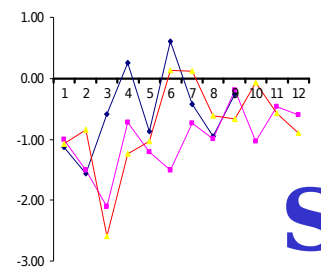
- **Data starts in 1929**
- **Graph compares monthly averages with the actual values for the 1999-2000 (where data are available).**
- **High flow period centers on March**
- **June to November period - steady, low flow**



Study Period:

- **1999 and 2000 were well below average**
- **Significantly, normal peak flow month both years lower by more than a standard deviation.**
- **Peak flow months for 1999 and 2000 barely distinguishable from the normal low flow months.**

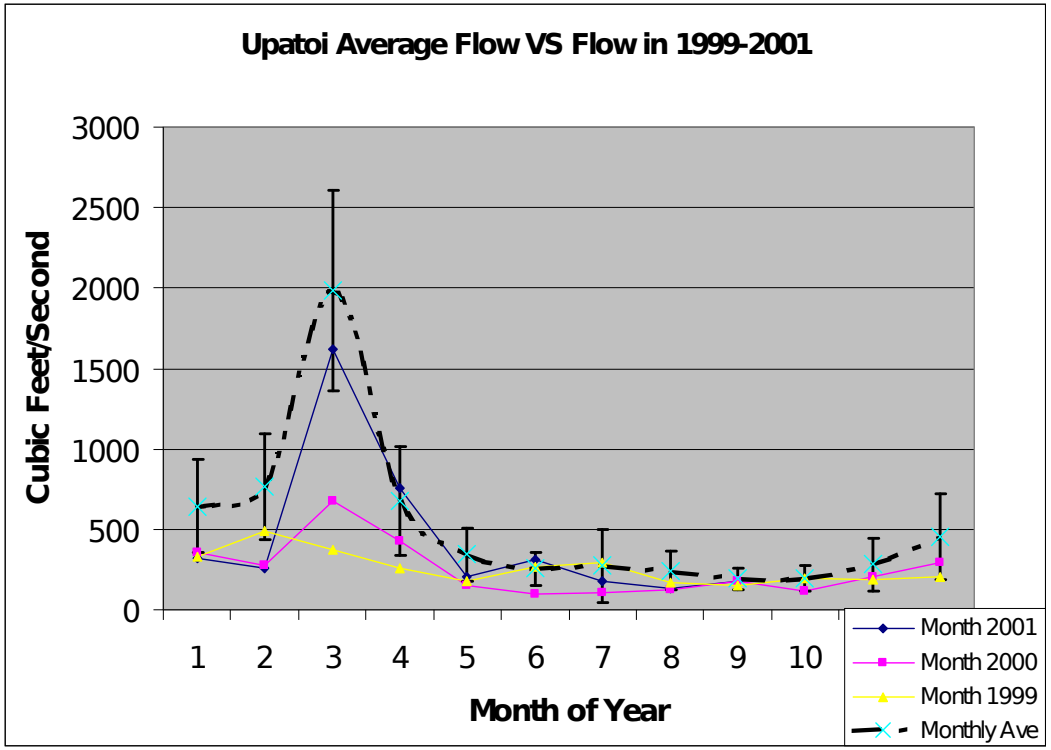
Historical



Stream Flow – Upatoi Creek

Comparing to the Chattahoochee

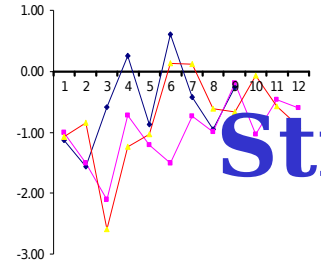
- **Data starts in 1968**
- **Similar high & low flow periods**
- **Similarly, well below average for 1999 and 2000**
- **Similar significantly lower flow in peak period.**



Comments:

- **Upatoi flow for 2001 is roughly average.**
- **Again, peak flow months for 1999 & 2000 are barely different than average low flow.**
- **Yearly water flow budget (the sum of the area under the curves) is normally determined in the February to May period and…**
- **For 1999 and 2000, the water flow budget was minimal**

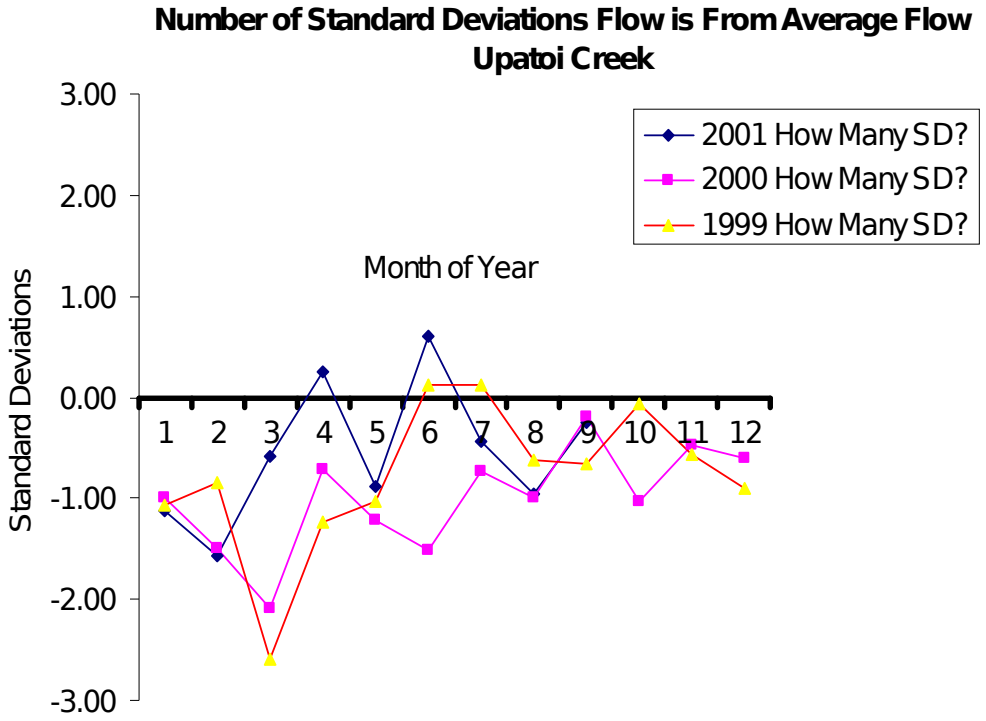
Historical



Stream Flow Variation – Upatoi Creek

Variation

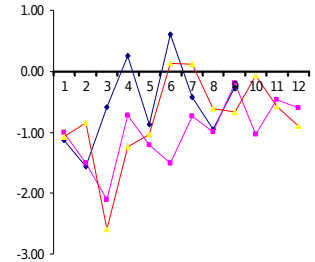
- **Greatest negative deviation is in critical months both years.**
- **2000 is consistently the most (lowest) aberrant.**
- **1999 is more aberrant in March: *2.6 standard deviations* from the average for that month.**



Comments:

- **High deviations are unusual but have occurred before (there are 10 months in 33 years of even greater variation than March 1999).**
- **Like other characteristics, low flow is an ecosystem system forcing event**
- **Forcing events help to define the limits of what a system can endure**

Historical



Conclusions - 1

"Just how aberrant have these initial collection seasons been in terms of precipitation?"

- **Precipitation more than one sigma below average for all three years.**

"Is this beyond the nature of the climate in the area?"

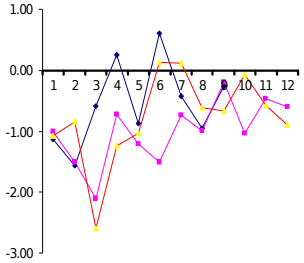
- **No. On time scales in the range of decades it is not an unusual aberration.**
- **However, the first years of the SEMP data gathering have captured a significant dry event – one end of the spectrum.**

"To what degree does the defined aberrant weather situation potentially affect, modify or disqualify those field results?"

- **For a program covering a temporal horizon of 25-30 years, it would appear this dry period is a normal, although unusually extended, part of the variation in the system.**

"Is it likely that the integration of the data for the years 2003-2009 will provide enough variation to adequately represent typical climate conditions?"

- **Climatic variations seem to occur in temporal scales greater than 25-35 years.**
- **The original basic SEMP temporal scale (10 years)**



Conclusions – 2

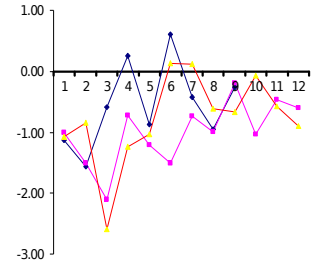
The three study years 1999-2001 represent a normal drought maximum.

- **Ecosystems respond to forcing agents.**
- **A drought is clearly such a forcing agent.**
- **We are fortunate we have captured one of the important ecosystem forcing events.**
- **It needs to be represented in the data and resulting models.**

When trying to represent the dynamics of the Benning region within conceptual models…

- **Researchers need to realize the current data probably represent a significant dry period but are within a normal cycle for precipitation.**
- **This drought as a forcing agent can be compared to fire as a forcing agent - although neither is a constant, each is integral to the definition of the ecosystem.**
- **Current SEMP acquired data probably do not represent the full normal distribution.**

Historical



Recommendations

1. **Recognize in models being developed that the data collected thus far are likely to represent the drought portion of normal variation.**
2. **Data to test the variation resulting from an ecosystem model cannot be represented using solely data collected during the period 1999-2001**
3. **To adequately capture the full range of expected fluctuation the term of long-term data collection should probably be at least 25-35 years**

Historical